Amendments to the Specification:

Please delete the paragraph beginning at page 2, line **[0005]**, which starts with "This previously described"

Please delete the paragraph beginning at page 3, line **[0012]**, which starts with "Also, the separation is"

Please delete the paragraph beginning at page 22, line **[0052]**, which starts with "The particle stream then"

Please delete the paragraph beginning at page 24, line **[0058]**, which starts with "The slide 53 will absorb"

Please delete the paragraph beginning at page 25, line **[0059]**, which starts with "Upon reaching the slide 50,"

Please delete the paragraph beginning at page 25, line **[0060]**, which starts with "The deflector 51, having a"

Please delete the paragraph beginning at page 25, line **[0061]**, which starts with "The particle and/or fluid"

Please add the following new paragraph **[0004.A]** after paragraph **[0004]**:

[0004.A]. One of the existent technologies, described in U.S. patents No. 2,003,899 and No. 5,259,510, uses a large volume of blown and sucked air to collect the particles to be filtered. Several steps are performed to break down the particle stream. Some steps

use deflectors and other steps entrain particles with blown or sucked air. Steps wherein air is blown to entrain the particles according to their different masses and allow to collect them further along in a filtration equipment. The sucked air is used to collect the volume of blown air and the entrained particle that are in suspension therein. This method uses relatively large volumes of air for lower-mass particles.

Please add the following news paragraphs **[0011.A], [0011.B], [0011.C], [0011.D], [0011.E], [0011.F], [0011.G], [0011.H], [0011.I], [0011.J], [0011.K], [0011.L], [0011.M], [0011.N]**, after paragraph **[0011]**:

[0011.A]. In a broad aspect, the invention provides a method for processing a stream of particles, the stream of particles flowing substantially along a stream flow direction. The method comprises directing a diluting flow of fluid towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction, the diluting flow of fluid having a velocity and density creating a jet stream such that the velocity pressure of the fluid produces a diluting impact force on the particles causing the particles to move in a direction substantially parallel to the diluting flow of fluid.

[0011.B]. In some embodiments of the invention, the method includes directing a diluting flow of fluid towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction, the diluting flow of fluid having a velocity and density such that the fluid produces a diluting impact force on the particles causing the particles to move over a first distance in a direction substantially parallel to the diluting flow of fluid while the fluid produces the separating impact force and to move over a second distance in a direction substantially parallel to the diluting flow of fluid after the fluid has produced the diluting impact force, the diluting impact force being of a magnitude and a duration such that:

[0011.C]. - the particles are substantially separated from each other by the diluting flow of fluid; and

[0011.D]. - the second distance is substantially larger than the first distance.

[0011.E]. For example, the diluting flow of fluid has a relatively high velocity pressure producing relatively high impact jet stream.

[0011.F]. In another broad aspect, the invention provides an apparatus for processing a stream of particles. The apparatus comprising:

[0011.G]. - a substantially upstanding dilution treatment chamber, the dilution treatment chamber defining an upper chamber end and an opposed lower chamber end, the dilution treatment chamber having a chamber passageway extending between the upper and lower chamber ends;

[0011.H]. - a source of compressed fluid; and

[0011.I]. - a nozzle 14, for creating a jet stream, the nozzle including

[0011.J]. - a nozzle inlet 40, in fluid communication with the source of compressed fluid;

[0011.K]. - a nozzle outlet 41, in fluid communication with the chamber passageway for releasing the jet stream into the chamber passageway;

[0011.L]. - a nozzle passageway 43, extending between the nozzle inlet and the nozzle outlet.

[0011.M]. For the purpose of this description, the term particle applies both to solid particles and to fluid droplets. Therefore, the above-described method and apparatus are both applicable to the processing of liquids.

[0011.N]. Also, for the purpose of this description, the term processing refers to any process performed on the particles. Examples of such processes include mixing, separating and treating the particles.

Please add the following news paragraphs **[0015.A], [0015.B]** after paragraph **[0015]**:

[0015.A]. In some embodiments of the invention, the method and apparatus lets the particles decelerate, agglomerate and settle in the transfer chamber 13, and exiting by the transfer chamber outlet 31.

[0015.B]. Advantageously, the claimed apparatus is able to process relatively large quantities of particles relatively fast.

Please add the following new paragraph **[0026.A]**, after paragraph **[0026]**:

[0026.A]. Fig. 11 is a schematic transversal section through the dilution treatment chamber 12, in order to clarify the details of the movable side wall of the passageway 20.

Please add the following news paragraphs **[0029.A], [0029.B], [0029.C], [0029.D], [0029.E], [0029.F], [0029.G],** after paragraph **[0029]**:

[0029.A]. The nozzle jet stream and the action of gravity~~;~~ **[[~~and host~~]]** perform a step of separation, and/or mixing and/ or treatment of the different components of the particle stream **[[~~into particle groups~~]]**.

[0029.B]. High impact is created by a high speed movement with a very short time exposure creating the velocity pressure jet stream. Jet stream is defined an a high impact speed air stream blowing and having high kinetic energy. The high impact force is proportional with the square of the velocity of the treatment fluid. For example, to obtain one hundred Newton forces with high velocity pressure, you will use one mass of treatment fluid by ten speed squares in comparison of hundred mass of treatment fluid by one speed square. This example prove that the speed of the treatment fluid is the most important factor to create the force.

[0029.C]. One other step to increase the dilution rate of the particle fluid stream is performed when the stream reaches the inlet of the passageway 20, of the dilution treatment chamber 12. A distributor 14, one or more nozzles 14, or both then dilute many times the previous mass concentration of the particle fluid stream. In embodiments of the invention wherein a nozzle 14, is present, the nozzle creates a treatment fluid jet stream, which in turn creates an impact force through the action of the high velocity pressure of the treatment fluid. As described in further details in this document, a relatively large high kinetic energy is thereby transferred to the components of the particle fluid stream to move the components for distributing the particle fluid stream on the cross section area of the dilution treatment chamber. These processes dilute many times the mass concentration of the particle fluid stream.

[0029.D]. After this step, the particle stream accelerates as it falls through the passageway 20, of the dilution treatment chamber 12. This further multiplicate the

dilution of the particles stream to obtain a dilution of the particles stream suitable for the next processes.

[0029.E]. The dilution achieved is related to the length of the passageway 20, and the dilution treatment chamber 12. This length allows for increasing the previous speed of the particle fluid stream, which is accelerating under the influence of gravity. Since the particle stream accelerates, mass conservation requires that the particle stream be diluted. This multiplication of the dilution is related on the speed up to which the particle stream is accelerated. The length of the dilution treatment chamber 12, and the location of the nozzles 14, are selected such that a dilution factor suitable to achieve successfully the separation, mixing or treatment to perform is obtained. After this step, the particle stream reaches at least one other nozzle that also produces a treatment fluid jet stream impact force with a high velocity pressure impacting through the particle stream in the dilution treatment chamber 12, to move the particle or fluid. The total distance over which the particles are moved depends on the masses of the different components of the particle stream and the magnitude of the impact force.

[0029.F]. At this stage, the particle stream has been diluted many times and its speed has been increased many times. The particles contain relatively large amounts of kinetic energy because of their relatively high speeds. Therefore, the velocity pressure with the high speed produced by a nozzle 14, is set for creating a relatively high impact force to move the particle stream over a first and also a second distance in transversally direction of the particle fluid steam in the falling direction. To perform this high impact force action, which is related to the square of the speed at the outlet 41, of the nozzle 14, by the mass of the treatment fluid, this method uses a relatively small amount of treatment fluid having a relatively high speed. The treatment fluid is then able to move laterally at least a portion of the particle stream without floating and entraining big amounts of air with the particle.

[0029.G]. The treatment fluid jet stream speed decreases faster than the speed of the particles that have been impacted by the treatment fluid due to the higher inertia of the particles. This causes the particles stream to move over a first and second distance due to ballistic effects, the total of which is relatively higher than a distance over which the

treatment fluid moves. The velocity pressure and the speed of the treatment fluid create relatively large effects with a relatively small volume of the treatment fluid.

Please add the following new paragraph **[0040.A],** after paragraph **[0040]**:

[0040.A]. Displacement of the gate 45 controls, at least in part, the rate and velocity of the treatment fluid so that the velocity of the treatment fluid is a predetermined velocity. The predetermined velocity controls at least in part the predetermined impact force to achieve a predetermined processing of the stream of particles. Other parameters of the apparatus 10 are also selectable so as to adjust the treatment fluid to obtain a predetermined impact force.

Please add the following new paragraph **[0041.A], [0041.B], [0041.C],** after paragraph **[0041]**:

[0041.A]. In other words, a stream of particles flowing substantially along a stream flow direction is diluted by a treatment fluid in the form of a diluting flow of fluid directed towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction.

[0041.B]. The diluting flow of fluid has a velocity and density such that the fluid produces a high impact with a diluting impact force on the particles causing the particles to move over a first distance in a direction substantially parallel to the diluting flow of fluid while the fluid produces the diluting impact force and to move over a second distance in a direction substantially parallel to the diluting flow of fluid after the fluid has produced the diluting impact force. The diluting impact force is of a magnitude and duration such that the particles are substantially separated from each other by the diluting flow of fluid the second distance is substantially larger than the first distance.

[0041.C]. In some embodiments of the invention, the movement of at least some of the particles caused by the diluting flow of fluid is such that the treatment fluid jet stream speed decreases faster than the speed of the particles that have been impacted by the treatment fluid due to the higher inertia of the particles. In other embodiments of the

invention, the high impact is such that the second distance is larger than the first distance.

Please add the following new paragraph **[0051.A]**, after paragraph **[0051]**:

[0051.A]. The particle stream then fall in the dilution treatment chamber for horizontal dilution by a distributor and/or a nozzle with additional multiplication of dilution cause by vertical gravity force acceleration and plurality of nozzles of the particle stream and more specifically, creating space between component for a relatively large dilution of mass/volume and a relatively large de-cohesion of the different components of particle stream.

Please add the following new paragraph **[0067.A]**, after paragraph **[0067]**:

[0067.A]. Fig. 11 illustrate a transversal section of the dilution treatment chamber 12, where is detailed the transversal movement of passageway side wall 20, used for adjusting the cross sectional area of the dilution treatment chamber 12.

Please replace paragraph **[0002]** with the following amended paragraph:

[0002] **[[**~~The present invention generally relates to the separation and mixing of particles and, more specifically, to a dry particle stream separator/mixer and methods for separating particle streams into particle groups and for mixing/treating particle groups.~~**]]** The present invention is concerned with a method and an apparatus for processing a stream of particles. . .

Please replace paragraph **[0004]** with the following amended paragraph:

[0004] Another known separation method is gravity separation by elutriation. In this process, a predetermined particle group is lifted by an airflow against the force of gravity. A finer particle **[[**~~group~~**]]** is collected by an upwardly positioned collector, whereas coarser particles overcome the airflow to be collected at a downwardly positioned collector. The amount and velocity of air has a direct effect on the particle group that is collected by the upwardly positioned collector.

Please replace paragraph **[0005]** with the following amended paragraph:

[0005] It is therefore an aim of the present invention ~~to~~ provides a novel apparatus and method for **[[**~~separating~~**]]** processing a stream of a particles **[[**~~stream into particle groups~~**]]**.

Please replace paragraph **[0006]** with the following amended paragraph:

[0006] It is a further aim of the present invention ~~to~~ causes a dilution of a particle stream and is related to the enhancement of different processes of the separation and/or mixing, and/or treating of the different particle stream components having different masses, separately and/or simultaneously **[[**~~into particle groups~~**]]**.

Please replace paragraph **[0007]** with the following amended paragraph:

[0007] It is a further aim of the present invention ~~to~~ provides a novel apparatus and method for separating, mixing, and treating different components of a particle stream having different masses separately and/or simultaneously **[[**~~groups into a particle stream~~**]]**.

Please replace paragraph **[0008]** with the following amended paragraph:

[0008] It is a further aim of the present invention is related to an apparatus **[[**~~that the apparatuses~~**]]** for separating a particle stream into different particle groups, and ~~for~~ mixing different particle groups into a particle stream ~~use~~ using minimum space and treatment fluid ~~air~~ volume so as to be cost and space efficient.

Please replace paragraph **[0009]** with the following amended paragraph:

[0009] It is a further aim of the present invention ~~to~~ provides a novel apparatus and method for separating particle streams into particle groups and mixing, treating different particle groups having different masses.

Please replace paragraph **[0011]** with the following amended paragraph:

[0011] A few factors are considered in creating separation, mixing or treating equipment. For instance, it is desired that the amount of [[~~fluid~~]] treatment fluid used in [[~~the process~~]] these processes be kept low. [[~~The fluid that is used for the separation will lose the particles it carries in suspension by settling~~]].

Please replace paragraph **[0012]** with the following amended paragraph:

[0012] [[~~Therefore,~~]] For example, and non-limitingly, in accordance with the present invention, there is provided an apparatus for separating different components of a particle stream or mixing or treating the same, or any combination thereof [[~~into particle groups;~~]]. The apparatus [[~~comprising~~]] includes a dilution treatment chamber 12, defining ~~an~~ for instance a parallelepipedic upstanding passageway [[~~channel~~]] 20, having a particle stream inlet 21, at a top end, and a dilution treatment chamber outlet 22, [[~~first particle group outlet~~]] at a bottom end, the dilution treatment chamber 12, [[~~channel~~]] being adapted to receive a particle stream at the [[~~particle~~]] inlet 21, such that the particle stream falls toward the dilution treatment chamber [[~~first particle group~~]] outlet 22; a transfer chamber [[~~casing~~]] 13, adjacent to the dilution treatment chamber 12, and defining a transfer chamber 13, adapted to receive a part or all the selected components separated from the particle stream; [[~~second particle group;~~]] a transfer chamber 13, sharing a wall 23, with the dilution treatment chamber 12; at least one transfer aperture 24, [[~~second particle group outlet~~]] laterally positioned with respect [[~~to the channel~~]] to ~~of~~ the dilution treatment chamber 12, and allowing [[~~fluid~~]] communication between the dilution treatment [[~~transfer~~]] chamber 12, and the transfer chamber [[~~channel~~]] 13; a distributor 14, in passageway the dilution treatment chamber 12, or a at least one nozzle 14, for creating the impact force produce by treatment fluid pressure-jet stream action [[~~channel~~]] situated between the particle stream inlet 25, and ~~the~~ at least one transfer aperture 24, [[~~second particle group outlet for breaking down the particle stream~~]] for mixing and distributing the different components of the particle stream over a surface area of the dilution treatment chamber [[~~channel~~]] 12, and; at least one treatment fluid ~~flow~~ aperture in the dilution treatment chamber 12, and below the distributor 14, adapted to allow the projection of the [[~~create a~~]] treatment fluid jet stream [[~~fluid flow~~]] between

the dilution treatment chamber 12, and the transfer chamber 13, [[~~and the channel so as to entrain a second particle group~~]] and through the particle stream, [[~~from the channel~~]] to project the selected components away through the transfer aperture 24, [[~~second particle group outlet to~~]] in the transfer chamber 13, and exiting through the transfer chamber outlet 31, with a part of particle stream [[~~first particle group~~]] remaining in the dilution treatment chamber 12, [[~~channel for~~]] and exiting through the dilution treatment chamber outlet 22, [[~~first particle group outlet~~]], the apparatus being adapted to be connected to a adjustable positive pressure source to create the different rate of jets stream pressure effect [[~~fluid flow~~]].

Please replace paragraph **[0013]** with the following amended paragraph:

[0013] [[~~Further~~]] In accordance with the present invention, there is also provided a method for separating different components having different masses of a particle stream into different groups [[~~particle groups~~]], or mixing or treating different components of particle comprising the steps of: i) spreading out [[~~breaking down~~]] the particle stream by subjecting the particle stream to a slide 50, for guiding and accelerating the stream in direction of to a deflector before inlet 21, of the dilution treatment chamber 12, [[~~lateral forces~~]]; ii) distributing a particle stream over a surface area of the dilution treatment chamber by subjecting the particle stream to a nozzle treatment fluid pressure effect, or a distributor 14, for horizontal dilution; iii) vertically diluting the particle stream by directing the particle stream in the dilution treatment chamber 12, to a falling condition accelerated by means of gravity; iv) projecting [[~~entraining a~~]] the different components of particle stream [[~~particle group away from a remainder of the particle stream by creating a~~]] by subjecting the particle stream to a treatment fluid [[~~flow of~~]] at predetermined [[~~magnitude~~]] or various velocity pressures through a nozzle 14, with adjustable orifice outlet 41, which produced the different pressure jet stream impact force related to the kinetic energy transformation creating a high impact. The treatment fluid impacts all or part of the different components depending of the adjustment of the fluid volume, velocity and pressure across the particle stream in said falling condition. The impact forces are transmitted to the different components of the particle stream in order to move and project them across the surface area and within the volume of the dilution treatment

chamber 12. The impact force increases the spacing between the particles. These impact force produce a relatively large mass dilution of the particles stream. These process dilute the particle masses for a instantly dilution of the previous masses. The dilution allows projection of the different component of particle stream away from a remainder for the separation process and let the different groups of components exit and separate locations. The jet stream projects all the different components in all directions in the dilution treatment chamber for mixing. These processes may also use any suitable treatment fluid for treating the particle stream [[~~and v)collecting the particle group and the remainder of the particle stream at separate locations.~~]]

Please replace paragraph **[0014]** with the following amended paragraph:

[0014] Still further in accordance with the present invention, there is provided an apparatus for at least one of mixing and treating particle and/or [[~~fluid~~]] stream, comprising a dilution treatment chamber 12, defining an upstanding passageway 20, [[~~channel~~]] having an inlet 21, at a top end, and an outlet 22, at a bottom end, the passageway 20, [[~~channel~~]] being adapted to receive said particle and/or fluid streams at the inlet such that said particle and/or streams fall toward the outlet; at least one treatment fluid ~~flow~~ aperture 25, in the dilution treatment chamber 12, adapted to create a generally lateral flow of at least one of a fluid and jet within the passageway 20, [[~~channel~~]] to create a turbulence in the passageway 20, [[~~channel~~]] for at least one of mixing said particle and/or [[~~fluid~~]] streams and treating said particle and/or fluid streams, whereby a mixture and/or treated matter will exit the passageway 20, [[~~channel~~]] at the outlet 22; and a positive pressure source connected to the fluid flow aperture to create the lateral flow of ~~the~~ at least one of the fluid and the particle with a jet stream having a high velocity pressure.

Please replace paragraph **[0015]** with the following amended paragraph:

[0015] Still further in accordance with the present invention, there is provided a method for at least one of treating and mixing particle and/or fluid streams, comprising the steps of: i) vertically diluting particle and/or fluid streams by directing particle and/or

fluid streams to a falling condition; ii) creating a lateral flow of fluid and/or a particle jet stream with high velocity pressure across the particle and/or fluid streams in said falling condition for at least one of mixing the particle and/or fluid streams by the a turbulence resulting from the lateral flow of fluid and/or particle jet stream, and treating said particle and/or fluid with a treatment fluid **[[~~streams~~]]**; and iii) collecting the mixture and/or treated matter below the lateral flow.

Please replace paragraph **[0016]** with the following amended paragraph:

[0016] Having thus generally described the nature of the invention, reference will now be made to the accompanying drawings, showing by way of illustration a preferred embodiment thereof and in which:

Please replace paragraph **[0017]** with the following amended paragraph:

[0017] Fig. 1 is a schematic view of an apparatus 10, for **[[~~separating a particles~~]]** processing a particle stream in accordance with a preferred embodiment of the present invention, and of a method for separating the particles stream;

Please replace paragraph **[0023]** with the following amended paragraph:

[0023] Fig. 7 is a perspective view of a recuperator tray of the apparatus;

Please replace paragraph **[0024]** with the following amended paragraph:

[0024] Fig. 8 is a schematic view of an mechanical distributor impeller used to create horizontal dilution **[[~~and separation~~]]** of a particle stream in accordance with an alternative embodiment of the present invention;

Please replace paragraph **[0027]** with the following amended paragraph:

[0027] It is pointed out that the present invention is associated with processing a stream of particles ~~the~~ for separating, ~~and~~ mixing or treating, or any combination thereof, the ~~of~~ different components having different properties of a particles stream. For example, the components have different masses. The term "particles stream" is broadly

used herein to designate a different component mass of particles, granules, pellets, and other elements such as any kind of solids and/or fluids of different mass and volume gathered together. Various uses of the present invention are defined hereinafter, for which the components and/or elements ~~mass~~ that ~~is~~ are processed **[[~~separated/mixed~~]]** is referred to as particle stream **[[~~unless stated otherwise;~~]]**. Also, the present invention uses the high velocity pressure of a jet stream which contains a relatively large kinetic energy. This energy is transferred at least in part to particles stream components to move, distribute, project, and settle the different components of the particle stream. A jet stream is defined on a high impact speed air stream blowing and producing high energy in relatively short time exposure.

Please replace paragraph **[0028]** with the following amended paragraph:

[0028] Referring to the drawings, and more particularly to Fig. 1, an apparatus for processing a stream of particles **[[~~separating a particle stream into particle groups is~~]]** generally shown at 10. The apparatus 10, shown in the drawings is a typical apparatus according to the invention. The reader skilled in the art will readily appreciate that many other geometric shapes and configurations are within the scope of the invention. The apparatus 10, has a substantially parallelepipedic dilution transfer chamber 12, a substantially parallelepipedic transfer chamber 13 adjacent to the dilution treatment chamber 12, sharing a wall 23, between the transfer chamber 13 and the dilution treatment chamber 12, **[[~~has a dilution treatment chamber 12, a transfer casing 13 adjacent to the dilution treatment chamber 12,~~]]** a nozzles 14 serially mounted on the dilution treatment chamber 12, and a pretreatment module 15. It is pointed out that the nozzles 14 are affixed with letters in various figures, whereby reference to the nozzles 14 will relate to all nozzles (e.g., nozzles 14A, 14B and 14C), while reference to a specific one of the nozzles will include an affixed letter.

Please replace paragraph **[0029]** with the following amended paragraph:

[0029] The dilution treatment chamber 12 performs a dilution of a particle stream by producing a de-cohesion of the different component gathered together in the particle

stream with a treatment fluid impact force. The treatment fluid is a fluid that is involved in the separation, mixing or any other suitable treatment of the particle stream. The impact force is created by a jet stream of a fluid. More specifically, the impact force is created by a high velocity pressure of the fluid exerted on the particles, which is the only component of the stress tensor describing the fluid/particle interaction that may produce an impact. The other non-zero components of this stress tensor represent frictional forces between the fluid and the particles. In some embodiments of the invention, the treatment fluid impact force creates a relatively large distance between the particles. The extent to which the particles are diluted on many parameters. For example, the following parameters influence the dilution: 1) surface area of the dilution treatment chamber12; 2) adjustment of the jet stream impact force; 3) number of stage of projection of the treatment fluid; 4) length of the dilution treatment chamber 12, among others. All these parameters determine the de-cohesion rate between each component and the dilution of the particle stream masses.

Please replace paragraph **[0030]** with the following amended paragraph:

[0030] The transfer chamber **[[~~casing~~]]** 13 is in fluid communication with the dilution treatment chamber 12 and receives a selected components groups of particle stream **[[~~group~~]]** and a **[[~~separated from the~~]]** remainder of the particle stream in the dilution treatment chamber 12.

Please replace paragraph **[0031]** with the following amended paragraph:

[0031] The nozzles 14 are used to create the dilution of the particle stream in the dilution treatment chamber 12 and to project a jet stream **[[~~inject fluid~~]]** (to be discussed hereinafter) that distributes, mixes, treats or separates **[[~~which breaks down~~]]** the different components of **[[~~mass of~~]]** particle stream **[[~~and/or enhance the dilution of the particles stream in the dilution treatment chamber 12~~]]**. Moreover, the nozzles 14 are used to project the treatment fluid in creating a **[[~~inject fluid~~]]** jet stream at different rate and velocity pressure which **[[~~separates~~]]** selects the type of process, by projecting away from a remainder for separating, in all directions the different components for mixing, by injecting the treatment fluid for treating the different components of particle stream **[[~~into~~**

~~the particle groups~~]]. All these processes may be performed sequentially or simultaneously, using one or a plurality of nozzles for separate or simultaneous processing.

Please replace paragraph **[0032]** with the following amended paragraph:

[0032] The pretreatment module 15 is used to guide [[~~and accelerate~~]] and spread out the particle stream toward the dilution treatment chamber 12, such that the particle stream will have predetermined ~~some~~ velocity. The velocity will cause a [[~~horizontal~~]] dilution of the particle stream.

Please replace paragraph **[0033]** with the following amended paragraph:

[0033] Referring concurrently to Figs. 1, 2 and 3, the typically parallelepipedic dilution treatment chamber 12 is shown having an upstanding elongated shape, and defines a substantially vertical passageway [[~~channel~~]] 20 of substantially rectangular cross-section. Although a rectangular cross-section is described, any other suitable cross-section shapes are contemplated. The passageway [[~~channel~~]] 20 has an inlet 21 at a top end thereof and an outlet 22 at a bottom end thereof. The dilution treatment chamber 12 shares a wall 23 with the preferably parallelepipedic transfer chamber [[~~casing~~]] 13. Transfer apertures [[~~lateral outlets~~]] 24, positioned opposite the treatment fluids aperture 25, are provided in the wall 23, between [[~~such that~~]] the dilution treatment chamber 12 and the transfer chamber [[~~casing~~]] 13, [[~~are in fluid communication~~]]. Moreover, the dilution treatment chamber 12 may vary in cross-sectional dimensions. For instance, appropriate translating mechanisms may be provided so as to increase/decrease a length or width of the cross-section parameters of the dilution treatment chamber 12.

Please replace paragraph **[0034]** with the following amended paragraph:

[0034] The dilution treatment chamber 12 also has treatment fluid pressure-differential apertures 25 (herein three apertures, i.e., treatment fluid ~~flow~~ apertures), two

of which are horizontally positioned opposite the transfer aperture [[~~lateral outlets~~]] 24 in the wall 23, between the dilution and transfer chamber.

Please replace paragraph **[0035]** with the following amended paragraph:

[0035] Referring concurrently to Figs. 1, 2 and 3, the transfer chamber [[~~casing~~]] 13 defines an inner transfer chamber 30. The inner transfer chamber 30 has a funnel-shaped outlet 31 at a bottom end thereof, so as to collect selected components of particle stream [[~~a particle group in suspension~~]] and allow deceleration and mass reconcentration of the components for settling in the transfer chamber ~~30~~ 13.

Please replace paragraph **[0036]** with the following amended paragraph:

[0036] Referring to Fig. 5, a lateral particle separator 60, in accordance with another embodiment of the present invention, is received in the inner transfer chamber 30 of the transfer chamber [[~~casing~~]] 13. The lateral particle separator 60 will be described in further detail hereinafter, and is used to cause a further particle group separation.

Please replace paragraph **[0037]** with the following amended paragraph:

[0037] Referring concurrently to Figs 1, 2 and 3, the nozzle 14B and 14C are positioned opposite the transfer aperture [[~~lateral outlets~~]] 24 of the dilution treatment chamber 12. The nozzle 14, ~~in~~ may take various geometric shape and configurations. For instance, the nozzle [[~~a preferred configuration;~~]] are connected to a pressure source so as to produce [[~~inject~~]] a treatment fluid jet stream [[~~gaseous~~]] (e.g. of any kind of elements) [[~~fluid (e.g., air or any other suitable gas, whereby reference will be made non-restrictively hereinafter to air or gaseous fluid)~~]] into the passageway [[~~channel 20~~]] of the dilution treatment chamber 12. For example, and non-limitingly, the fluid includes air or any other suitable gas.

Please replace paragraph **[0038]** with the following amended paragraph:

[0038] Referring to Fig. 4, one of the nozzle 14 is illustrated in greater detail. The nozzle 14 has an inlet 40, by which it is connected to a pressure source, and an outlet 41

of elongated [[~~rectangular~~]] shape. The nozzle 14 has a diffusing divergent/convergent body 42 between the inlet 40 and the outlet 41.

Please replace paragraph **[0039]** with the following amended paragraph:

[0039] In a preferred embodiment of the present invention, the diffusing body 42 has an accumulator portion 43 connected to the inlet 40, and convergent tapered diffusing sectors 44 between the accumulator portion 43 and the outlet 41. The diffusing sectors 44 are used in order to create a substantially uniform diffusion of treatment fluid ~~air~~ out of each of the nozzle 14.

Please replace paragraph **[0040]** with the following amended paragraph:

[0040] A gate 45 is displaceable vertically for the adjustment of the height of the outlet and surface area 41. A connection flange 46 is used to secure the nozzle 14 to the dilution treatment chamber 12 opposite the treatment fluid [[~~pressure differential~~]] apertures 25. It is also seen in Figs. 2 and 3 that the gate 45 can be accessed from an exterior of the apparatus 10, thereby enabling the rapid adjustment of the outlet size of the nozzle 14 from an exterior of the apparatus 10.

Please replace paragraph **[0041]** with the following amended paragraph:

[0041] The above-described configuration of the nozzle 14 enables a high-pressure, low-volume output of treatment fluid [[~~gaseous fluid~~]] into the dilution treatment chamber 12 to produce a high impact ~~on~~ which is created by a high velocity pressure jet [[~~the particle~~]] stream (e.g. moving at a relatively fast rate with short time exposure) with a relatively large kinetic energy, this energy being transferred at least in part to the particles for projecting the particles at different distances depending of their masses and other characteristics.

Please replace paragraph **[0042]** with the following amended paragraph:

[0042] Accordingly, the output of treatment fluid jet stream [[~~gaseous fluid~~]] will decelerate at a high rate, and shut down rapidly in accordance with the distance, so as to

project [[~~a entrain~~]] in some instances described hereinafter given selected particle [[~~group~~]] out of the dilution treatment chamber 12, for separation and to avoid creating [[~~enhancing~~]] turbulence in the transfer chamber 13. [[~~Such turbulence would slow down the settling process in the transfer chamber 30, for instance, if the apparatus 10 were used for classifying particle groups~~]]. Also the treatment fluid is used for enhancing different processes of mixing and treating the different components of particle stream by impacting and projecting them in all directions in the dilution treatment chamber.

Please replace paragraph **[0043]** with the following amended paragraph:

[0043] Referring concurrently to Figs. 1, 2 and 3, the pretreatment module 15 is connected to the [[~~positioned at the~~]] inlet 21 of the dilution treatment chamber 12. The pretreatment module 15 conveys the particle stream [[~~from a particle stream source, such as conveyor C~~]], to the inlet 21 of the dilution treatment chamber 12. More specifically, the pretreatment module 15 will be used to produce specific passageway inlet conditions of the [[~~for the~~]] particle stream.

Please replace paragraph **[0044]** with the following amended paragraph:

[0044] In a preferred embodiment of the present invention, the pretreatment module 15 has a slide 50, sloping downwardly towards the inlet 21 of the dilution treatment chamber 12. A deflector 51 is positioned between the slide 50 and the inlet 21 of the passageway [[~~channel~~]] 20. The deflector 51 has a generally horizontal launch surface, but may also be oriented otherwise. As seen in Figs. 2 and 3, the slide 50 tapers towards the inlet 21 of the dilution treatment chamber 12, so as to have an outlet 22, width generally equal to the inlet 21, width of the passageway [[~~channel~~]] 20 of the dilution treatment chamber 12. The slide 50 is preferably provided with guiding rails 52 for guiding the particle stream (Figs. 2 and 3). The particle stream reaching the slide 50 is preferably uniformly distributed toward the inlet 21 of the dilution treatment chamber 12, [[~~and the guiding rails 52 are provided to this effect~~]].

Please replace paragraph **[0045]** with the following amended paragraph:

[0045] A further slide 53 is optionally provided above the slide 50 so as to dampen the fall of the particle stream from the conveyor C. The slide 53 will absorb a portion of the downward force, and will absorb the lateral velocity transmitted from the conveyor C to the particle stream, such that the particle stream reaches the dilution treatment chamber 12 at predetermined velocity parameters.

Please replace paragraph **[0046]** with the following amended paragraph:

[0046] It is contemplated to provide various geometries configuration to the pretreatment module 15. For instance, the slide 50 is herein illustrated as being generally a flat, inclined surface. However, it is contemplated to provide the slide 50 with a downwardly-tapered frusto conical shape, **[[**~~whose smallest cross-section would meet the inlet 21 of the dilution treatment chamber 12~~**]]**. Moreover, for such an embodiment, the slide 53 preferably has an upright conical shape.

Please replace paragraph **[0047]** with the following amended paragraph:

[0047] The apparatus 10, can process simultaneously or separately the particle stream for separation, mixing, or treatment. Now that the various components of the apparatus 10 have been described, the processing operation of a stream of particles **[[**~~a separation operation~~**]]** of the apparatus 10 is set forth.

Please replace paragraph **[0048]** with the following amended paragraph:

[0048] Referring concurrently to Figs. 1, 2 and 3, a particle stream is fed by the conveyor C to the apparatus 10. The particle stream has a vertical **[[**~~lateral~~**]]** velocity and will accelerate downwardly when leaving the conveyor C due to gravitational forces.

Please replace paragraph **[0049]** with the following amended paragraph:

[0049] The slide 53 will absorb a portion of the downward force of the particle stream, and stop the lateral velocity of the particle stream that had been transferred to the particle stream by the action of the conveyor C. The **[[**~~mass of~~**]]** particle stream is

directed by the slide 53 toward the slide 50 of the pretreatment module 15, at generally predetermined velocity conditions.

Please replace paragraph **[0051]** with the following amended paragraph:

[0051] The deflector 51, having a launch surface, will deflect the particle stream so as to spread out **[[~~initiate a break up of~~]]** the **[[~~mass of~~]]** particles stream. A **[[~~lateral~~]]** dilution will be the result of the deflection of the particle stream by the deflector 51. Accordingly, the particle stream will reach the dilution treatment chamber 12, having been subjected to a ~~mass~~ dispersion for the next dilution by the treatment fluid velocity pressure produce with the nozzle 14, or with the distributor 14. Also the pre-treatment module are use for fluids stream **[[~~break up and to a horizontal dilution.~~]]**

Please replace paragraph **[0052]** with the following amended paragraph:

[0052] A first one of the nozzles 14, namely nozzle 14A, will project a treatment fluid jet stream **[[~~inject air~~]]** within the passageway **[[~~channel~~]]** 20 of the dilution treatment chamber 12 so as to cause a de-cohesion of the component and a mixing and distribution the different components of the particle stream over the cross-sectional area of the dilution treatment chamber **[[~~break up of the mass of particle stream into particle groups (i.e., breaking down the mass of particle stream)~~]]** and **[[~~spread out,~~]]** dilute and~~/or~~ creating space between the particles ~~groups~~. **[[~~This nozzle 14A is also referred to as a distributor, as it will be distributing the particle stream over a surface area of the channel 20.~~]]** As an alternative to a nozzle 14, a distributors 14, **[[~~the apparatus 10~~]]** may be provided with vibrating strainers, impellers, or the like, as will be illustrated hereinafter.

Please replace paragraph **[0053]** with the following amended paragraph:

[0053] The particle stream, having been subjected to a horizontal and a vertical dilution for a maximum de-cohesion of the different component before the next step of the treatment which continuing the de-cohesion in the same time of processing the treatment, the particle stream now subjected to a relatively large de-cohesion creating a dilution **[[** ~~(i.e., break up or distribution),~~**]]** will be crossing a **[[~~horizontal flow~~]]** treatment fluid jet

stream [[~~of air~~]] substantially perpendicular to the particle stream in said falling direction projected [[~~as injected~~]] by [[~~the second~~]] at least one others nozzle 14B, and the optional third nozzle 14C. The nozzles 14B and 14C [[~~inject~~]] project ~~air~~ treatment fluid, at a predetermined or variable pressure effect through the treatment fluid aperture 25, which are positioned opposite the transfer aperture [[~~lateral outlets~~]] 24, such that the treatment fluid jet stream ~~air~~ will project the selected components of particle stream in the dilution treatment chamber [[~~carry the finer particle group~~]] through the particle stream and/or out of the dilution treatment chamber 12. [[~~channel 20,~~]] by the opening through the transfer aperture [[~~lateral outlets~~]] 24, ~~and~~ into the [[~~inner~~]] transfer chamber [[~~of the transfer casing~~]] 13, with ~~in~~ a high ratio of particle treatment fluid [[~~to air~~]] concentration. The projected treatment fluid [[~~air injected~~]] by the nozzles 14 is at the predetermined pressure, such ~~that~~ the other particles will not be projected out and remain in the particle stream depending. In other words, some particles are projected over a larger distance, which creates a separation of these particles from other particles present in the stream of particles [[~~coarse particle group will not be entrained out of the channel 20 by the air flow~~]]. The dilution that has taken place previously is an important factor in the different processes of separation, mixing or treating [[~~of the fine particles from the coarse particles~~]]. The magnitude of the pressure of treatment fluid projected [[~~air injection~~]] will have a direct effect on the particles being withdrawn from the particle stream in the dilution treatment chamber [[~~channel~~]] 20. It is pointed out that the vertical distance from the inlet 21 to the nozzle 14B is an important [[~~essential~~]] factor in diluting the particle stream to facilitate the subsequent [[~~separation~~]] processes [[~~of the particle groups~~]] so as to increase the contact with the treatment fluid [[~~fluid/particle contact~~]].

Please replace paragraph **[0054]** with the following amended paragraph:

[0054] Although plurality of [[~~three~~]] nozzles (namely 14A, 14B and 14C) are described, the number of nozzles 14 is variable according to the present invention. The apparatus 10 is operative with a single nozzle 14 including [[~~opposite an~~]] a treatment fluid aperture 25, but a plurality of nozzles 14 may be serially added on the dilution

treatment chamber 12 to increase the efficiency of the operation taking place within the dilution treatment chamber 12.

Please replace paragraph **[0055]** with the following amended paragraph:

[0055] Thereafter, the selected ~~fine~~ particle **[[~~group~~]]** exits through the transfer chamber outlet 31 at the bottom of the **[[~~inner~~]]** transfer chamber ~~30~~ 13 **[[~~of the transfer casing 13~~]]** after settling, whereas the remaining particle stream **[[~~coarse particle group~~]]** continues its drop into the dilution treatment chamber 12 toward the dilution treatment chamber outlet 22.

Please replace paragraph **[0056]** with the following amended paragraph:

[0056] As mentioned previously, the apparatus 10 of the present invention is usable **[[~~can also be used~~]]** for simultaneous or separately process and for mixing, **[[~~and/or~~]]** treating the different components of particle stream, depending on the adjustment of the nozzle 14, the dilution rate and the impact force **[[~~particle and/or fluid streams~~]]**. Therefore, a processing mixing/treating operation of the apparatus 10 is set forth.

Please replace paragraph **[0057]** with the following amended paragraph:

[0057] Referring to Fig. 1, particle **[[~~and/or fluid~~]]** streams to mix/ and/or treat **[[~~are fed by the conveyor C, and possibly other conveyors or particle and/or fluid sources (not shown) to the apparatus 10. The particle and/or fluid streams~~]]** have horizontal and vertical **[[~~a lateral~~]]** dilution velocity and will accelerate downwardly when leaving their source due to gravitational forces as similarly set for the separate process, just different adjustment will be take place as described previously.

Please replace paragraph **[0058]** with the following amended paragraph:

[0058] A first one of the nozzles, namely nozzle 14A, will laterally project treatment fluid jet stream with velocity pressure effect **[[~~inject fluid,~~]]** or any other suitable fluid or particle jet, within the **[[~~channel~~]]** passageway 20 of the dilution treatment chamber 12 so

as to cause a turbulence; and move in all directions the different components of particle stream for another step of de-cohesion for [[a mix;]] mixing and/or treating [[or a treatment of]] the particle and/or fluid streams. The treatment fluid jet stream [[fluid/particle injected]] projected by the nozzle 14A at a is of predetermined pressure depending of the adjustment of the pressure source and the nozzle gate 41, to produce the different jet stream impact forces through the particle stream to be mixed so as to have a variable effect relative to the size, mass and other characteristics of the particles and/or fluid streams. The nozzle 14A fluid projects [[injects air]] treatment fluid, or any other suitable fluid, at high pressure and low volume.

Please replace paragraph **[0059]** with the following amended paragraph:

[0059] In option, we can use the opposite transfer apertures [[lateral outlets]] 24 which are not used in the mixing process of the apparatus 10. The nozzles 14B and 14C are optionally used with the opposite transfer aperture [[lateral outlets]] 24 being blocked with the gate 26, so as to create further turbulence, as it is contemplated to provide a plurality of the nozzles 14 to [[enhance]] create different rate of the mixing of different components of particle [[and/or fluid]] stream in the dilution treatment chamber [[channel]] 20, [[or for]] and treating the different component particle stream by the treatment fluid injected [[and/or fluid streams]]. Additional nozzles may also be added to the apparatus 10.

Please replace paragraph **[0060]** with the following amended paragraph:

[0060] Thereafter, the mix or treated matter, resulting from the mix/treatment of the particle and/or agent stream [[fluid streams]], continues its drop into the deconcentration [[dilution]] treatment chamber 12 toward the outlet 22. Also the transfer aperture are use for exiting the mixed or treated particle stream.

Please replace paragraph **[0063]** with the following amended paragraph:

[0063] More specifically, the lateral distributor 60 operates with the principle that the distance traveled [[by the particles carried in the flow of air from the dilution treatment

~~chamber 12~~]] is a function of the particle size parameters (e.g., surface area, mass). Accordingly, coarser particles will travel a shorter distance than finer ones, whereby the coarser particles will be collected by the upstream sector 61. Therefore, a further particle group separation takes place with the lateral distributor 60. The hence separated particle groups are collected separately at the segmented outlet portion 62.

Please replace paragraph **[0064]** with the following amended paragraph:

[0064] Referring to Figs. 3 and 7, recuperation trays 70 are provided below each of the transfer apertures [[~~lateral outlets~~]] 24 of the dilution treatment chamber 12. More specifically, it is possible that components of particle stream [[~~particles~~]] that should selectively remain with the dilution treatment chamber 12 are deflected out of the transfer aperture [[~~lateral outlets~~]] 24. [[~~It is anticipated that~~]] These [[~~coarser~~]] particles will not travel a long distance out of the transfer aperture [[~~lateral outlets~~]] 24 due to their ~~size~~ mass parameters. Accordingly, the recuperation trays 70 are provided to collect these particles, as they are positioned directly below the apertures 24. These particles are returned to the dilution treatment chamber 12 by the sloping shape of the recuperation trays 70.

Please replace paragraph **[0065]** with the following amended paragraph:

[0065] Moreover, the recuperation tray 70 illustrated in Fig. 7 [[~~also effects a~~]] have various configurations also effects a particle separation. More specifically, the recuperation tray 70 ~~as~~ has a first sector 71 and a second sector 72. The first sector 71 collects the particles that should not have left the dilution treatment chamber 12, whereas the second sector 72 collects rapidly falling particles, of a grade just below that of the particle group remaining within the dilution treatment chamber 12. It is pointed out that the second sector 72 is connected to its own outlet.

Please replace paragraph **[0066]** with the following amended paragraph:

[0066] Also, the recuperation tray 70 may be pivotally connected at a bottom edge thereof to the wall of the dilution treatment chamber 12. This would enable adjustment of

an angle of the recuperation tray 70 with regard to the vertical, as a function of the particle stream/ [[~~particle group~~]] being selected [[~~separated~~]].

Please replace paragraph **[0067]** with the following amended paragraph:

[0067] Fig. ~~12~~ 8 and ~~13~~ 9 illustrate alternatives of the nozzle 14A [[~~for use in the dilution process~~]]. In Fig. 8, an impeller is shown at 80. In Fig. 9, a laterally reciprocating strainer is generally shown at 90. Both these alternatives will cause a dispersion and [[~~horizontal~~]] dilution of the particle stream. Other alternatives include ~~fans~~, electrostatic or magnetic emitters (e.g., in accordance with the type of particles stream being treated), as well as any mechanical or ultrasound system.

Please replace paragraph **[0068]** with the following amended paragraph:

[0068] It is also contemplated to inject additives to the particle stream being diluted in the dilution treatment chamber 12. For instance, an aperture such as one of the treatment fluid pressure-differential apertures 25 can be used with a suitable injection system (e.g., [[~~blower~~]] pressure source and conduit combination) to inject any kind of treatment agent [[~~color (e.g., in the form of a powder)~~]] to the particle stream being diluted in the dilution treatment chamber 12, or to particle [[~~groups~~]] being mixed therein.

Please replace paragraph **[0069]** with the following amended paragraph:

[0069] It is also contemplated to provide a plurality of the apparatus 10 in series, with a conveying system transporting/conveying the output of an upstream one of the apparatus 10 to a downstream one. Alternatively, a pair (or more) of the apparatus 10 may be positioned in parallel and/or share a common transfer chamber ~~30~~ 13, to collect a specific component of particle stream [[~~particle group~~]]. In such a case, the transfer chamber ~~30~~ 13 could be used to mix a different components of particle stream [[~~particle group~~]] from a first dilution treatment chamber 12 with other components of particle stream [[~~a particle group~~]] of a second dilution treatment chamber 12.

Please replace paragraph **[0070]** with the following amended paragraph:

[0070] For instance, referring to Fig. 10, an apparatus in accordance with an alternative embodiment of the present invention is generally shown at 10'. The apparatus 10' is similar to the apparatus 10 of Fig. 1 in that the apparatus 10' has a dilution treatment chamber 12, nozzles 14 (herein four nozzles for the dilution treatment chamber 12), and a pretreatment module 15'. The pretreatment module 15' shows a different shape (e.g., with a conical slide 53'), but operates in a fashion similar to that of the pretreatment module 15. The apparatus 10' has a transfer chamber **[[~~casing~~]]** 13' in which a secondary separation and/or mix and/or treat is performed.

Please replace paragraph **[0071]** with the following amended paragraph:

[0071] More specifically, the transfer chamber **[[~~casing~~]]** 13' has a transfer plate 100, a dilution treatment chamber 102, nozzles 104, and a second transfer chamber **[[~~subcasing~~]]** 106. The components of particle stream **[[~~particle group~~]]** reaching the transfer chamber **[[~~casing~~]]** 13' from the dilution treatment chamber 12 will drop into the inlet of the dilution treatment chamber 102, or will settle onto the transfer plate 100, to then reach the inlet of the dilution treatment chamber 102.

Please replace paragraph **[0073]** with the following amended paragraph:

[0073] The dilution treatment chamber 102 is illustrated having the nozzles 104A, 104B, and 104C. The nozzle 104A serves the same function as the nozzle 14A of Fig. 1, namely to distribute **[[~~break down~~]]** the particle stream **[[~~group~~]]** that has reached the dilution treatment chamber 102. The nozzle 104A can be replaced with other devices, such as those illustrated in Figs. ~~12~~ 8 and ~~13~~ 9.

Please replace paragraph **[0074]** with the following amended paragraph:

[0074] The nozzles 104B and 104C serve the same function as the nozzles 14B and 14C of Fig. 1, and are thus positioned opposite the transfer aperture **[[~~lateral outlets~~]]** 110, through which selected components of particle stream a **[[~~particle group~~]]** will be forced out, to reach the transfer chamber **[[~~subcasing~~]]** 106 and settle therein. The removed particle **[[~~group~~]]** will exit through outlet 112, whereas the remaining particles

~~[[group remaining in the dilution treatment chamber 102]]~~ will exit through dilution treatment chamber outlet 114. Recuperation trays 116 are adjustable similarly to the recuperation trays 70 of the preferred embodiment.

Please replace paragraph **[0075]** with the following amended paragraph:

[0075] Accordingly, the output of the apparatus 10' are ~~is~~ three different components particle groups, with their separated and/or mixed, and/or treated ~~the~~ particle group exiting from the passageway 20, 102, and transfer chamber **[[**~~subcasing~~**]]** 106 **[[**~~being the finest~~**]]**. It is pointed out that the treatment fluid jet stream **[[**~~gaseous fluid~~**]]** output of the nozzles 14 and 104 is adjusted in view of the desired ~~size~~ process of the stream of particles selected **[[**~~particle groups~~**]]**. The dilution transfer chamber **[[**~~casing~~**]]** 13' **[[**~~can be~~**]]** are used for separating, mixing or treating, as described previously for the apparatus 10.

Please replace paragraph **[0076]** with the following amended paragraph:

[0076] Amongst the various process that can take place with the apparatus 10-10' of the present invention, it is contemplated to separate, treat, **[[**~~classify (with an initial step of separation)~~**]]**, mix, add, vaporize, clean, calibrate, or eliminate components **[[**~~fines~~**]]** from particle streams. Other treatments, such as painting, coating, sandblasting, ~~or~~ cleaning, and so forth can be effected with the apparatus 10-10' of the present invention. Existing batch processes, such as the injection of gas or chemicals into soft drinks, can be converted to continuous processes using the present invention.

Please replace paragraph **[0077]** with the following amended paragraph:

[0077] The differential velocity pressure in the dilution treatment chamber 12 can be controlled electronically and the apparatus 10 may be combined to magnetic, electrical, ultrasound, electronic, and electromagnetic systems.

Please replace paragraph **[0078]** with the following amended paragraph:

[0078] The apparatus 10-10' can be used with all kinds of materials, such as: mineral, vegetable, biological, or organic aggregates, as well as with fertilizers, treatment or transformation residues, waste, food products, drugs and other pharmaceutical products, powders, agriculture related products, chemical or metallurgical products, compost, plastics and composites, paper, soil and bio-soil, ashes, crushed stone, ceramics, coal, and any kind of suitable elements.

Please replace paragraph **[0079]** with the following amended paragraph:

[0079] The apparatus 10-10' of the present invention is relatively small. Accordingly, it is possible to place the apparatus 10-10' at various parts of a process due to these advantageous features. The apparatus 10-10' enables large quantities of particles/[[~~fluid~~]] streams to be treated in a relatively limited amount of space, with little wear of material, low energy consumption and, in some embodiments, no moving parts (i.e., depending on the choice of the type of dilution).

Please replace paragraph **[0080]** with the following amended paragraph:

[0080] The apparatus 10-10' can be used as part of a multi-step or multi-pass process. [[~~Moreover although,~~]] For instance, the preferred embodiment includes ~~only~~ a transfer chamber 13, 106, [[~~settling cavity~~]] for the collection of the selected particles, [[~~an outflow of air for the particles remaining in suspension can be added as an option~~]]. The apparatus 10-10' is made of rigid materials, such as metals, polymers, and so forth. It is pointed out that aside from the slide 53, the apparatus 10-10' goes through limited wear.

APPARATUS AND METHOD FOR PROCESSING A STREAM OF PARTICLES

[0001] This application claims priority on Canadian Patent Applications No. 2,421,246, filed on February 12, 2003, No. 2,419,451, filed on February 21, 2003, and No. 2,435,086, filed on July 18, 2003.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention is concerned with a method and an apparatus for processing a stream of particles.

2. Background Art

[0003] Previously known techniques and methods are currently used for the separation of aggregates into particle groups. For instance, gravity classifiers, inertial classifiers, centrifugal classifiers, and cyclone separators are well known and used technologies. Amongst other patents, Canadian Patent No. 2,257,674, issued on January 7, 2003 to Cordonnier et al., discloses an air classifier with centrifugal action. Canadian Patent Applications No. 2,068,935 (by Tyler et al.) and 2,294,829 (by Gruenwald) respectively describe an air separator and an air classification of water-bearing fruit and vegetable ingredients for peel and seed removal and size discrimination.

[0004] Another known separation method is gravity separation by elutriation. In this process, a predetermined particle group is lifted by an airflow against the force of gravity. A finer particle is collected by an upwardly positioned collector, whereas coarser particles overcome the airflow to be collected at a downwardly positioned collector. The amount and velocity of air has a direct effect on the particle group that is collected by the upwardly positioned collector.

[0004.A] One of the existent technologies, described in U.S. patents No. 2,003,899 and No. 5,259,510, uses a large volume of blown and sucked air to collect the particles to be filtered. Several steps are performed to break down the particle stream. Some steps use deflectors and other steps entrain particles with blown or sucked air. Steps wherein air is blown to entrain the particles according to their different masses and allow to collect them further along in a filtration equipment. The sucked air is used to collect the volume of blown air and the entrained particle that are in suspension therein. This method uses relatively large volumes of air for lower-mass particles.

SUMMARY OF INVENTION

[0005] It is therefore an aim of the present invention provides a novel apparatus and method for processing a stream of particles.

[0006] It is a further aim of the present invention causes a dilution of a particle stream and is related to the enhancement of different processes of the separation and/or mixing, and/or treating of the different particle stream components having different masses, separately and/or simultaneously.

[0007] It is a further aim of the present invention provides a novel apparatus and method for separating, mixing, and treating different components of a particle stream having different masses separately and/or simultaneously.

[0008] It is a further aim of the present invention is related to an apparatus for separating a particle stream into different particle groups, and mixing different particle groups into a particle stream using minimum space and treatment fluid volume so as to be cost and space efficient.

[0009] It is a further aim of the present invention provides a novel apparatus and method for separating particle

streams into particle groups and mixing, treating different particle groups having different masses.

[0010] It is a further aim of the present invention to reduces a need for conventional dust collection systems.

[0011] A few factors are considered in creating separation, mixing or treating equipment. For instance, it is desired that the amount of treatment fluid used in these processes be kept low.

[0011.A] In a broad aspect, the invention provides a method for processing a stream of particles, the stream of particles flowing substantially along a stream flow direction. The method comprises directing a diluting flow of fluid towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction, the diluting flow of fluid having a velocity and density creating a jet stream such that the velocity pressure of the fluid produces a diluting impact force on the particles causing the particles to move in a direction substantially parallel to the diluting flow of fluid.

[0011.B] In some embodiments of the invention, the method includes directing a diluting flow of fluid towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction, the diluting flow of fluid having a velocity and density such that the fluid produces a diluting impact force on the particles causing the particles to move over a first distance in a direction substantially parallel to the diluting flow of fluid while the fluid produces the separating impact force and to move over a second distance in a direction substantially parallel to the diluting flow of fluid after the fluid has produced the diluting impact force, the diluting impact force being of a magnitude and a duration such that:

[0011.C] the particles are substantially separated from each other by the diluting flow of fluid; and

[0011.D] the second distance is substantially larger than the first distance.

[0011.E] For example, the diluting flow of fluid has a relatively high velocity pressure producing relatively high impact jet stream.

[0011.F] In another broad aspect, the invention provides an apparatus for processing a stream of particles. The apparatus comprising:

[0011.G] a substantially upstanding dilution treatment chamber, the dilution treatment chamber defining an upper chamber end and an opposed lower chamber end, the dilution treatment chamber having a chamber passageway extending between the upper and lower chamber ends;

[0011.H] a source of compressed fluid; and

[0011.I] a nozzle 14, for creating a jet stream, the nozzle including

[0011.J] a nozzle inlet 40, in fluid communication with the source of compressed fluid;

[0011.K] a nozzle outlet 41, in fluid communication with the chamber passageway for releasing the jet stream into the chamber passageway;

[0011.L] a nozzle passageway 43, extending between the nozzle inlet and the nozzle outlet.

[0011.M] For the purpose of this description, the term particle applies both to solid particles and to fluid droplets. Therefore, the above-described method and apparatus are both applicable to the processing of liquids.

[0011.N] Also, for the purpose of this description, the term processing refers to any process performed on the particles. Examples of such processes include mixing, separating and treating the particles.

[0012] For example, and non-limitingly, in accordance with the present invention, there is provided an apparatus for

separating different components of a particle stream or mixing or treating the same, or any combination thereof. The apparatus includes a dilution treatment chamber 12, defining for instance a parallelepipedic upstanding passageway 20, having a particle stream inlet 21, at a top end, and a dilution treatment chamber outlet 22, at a bottom end, the dilution treatment chamber 12, being adapted to receive a particle stream at the inlet 21, such that the particle stream falls toward the dilution treatment chamber outlet 22; a transfer chamber 13, adjacent to the dilution treatment chamber 12, and defining a transfer chamber 13, adapted to receive a part or all the selected components separated from the particle stream; a transfer chamber 13, sharing a wall 23, with the dilution treatment chamber 12; at least one transfer aperture 24, laterally positioned with respect to the dilution treatment chamber 12, and allowing communication between the dilution treatment chamber 12, and the transfer chamber 13; a distributor 14, in passageway the dilution treatment chamber 12, or a at least one nozzle 14, for creating the impact force produce by treatment fluid pressure-jet stream action situated between the particle stream inlet 25, and at least one transfer aperture 24, for mixing and distributing the different components of the particle stream over a surface area of the dilution treatment chamber 12, and; at least one treatment fluid aperture in the dilution treatment chamber 12, and below the distributor 14, adapted to allow the projection of the treatment fluid jet stream between the dilution treatment chamber 12, and the transfer chamber 13, and through the particle stream, to project the selected components away through the transfer aperture 24, in the transfer chamber 13, and exiting through the transfer chamber outlet 31, with a part of particle stream remaining in the dilution treatment chamber 12, and exiting through the dilution treatment chamber outlet 22, the apparatus being adapted to be connected to a adjustable

positive pressure source to create the different rate of jets stream pressure effect.

[0013] In accordance with the present invention, there is also provided a method for separating different components having different masses of particle stream into different groups, or mixing or treating different components of particle comprising the steps of: i) spreading out the particle stream by subjecting the particle stream to a slide 50, for guiding and accelerating the stream in direction of to a deflector before inlet 21, of the dilution treatment chamber 12; ii) distributing a particle stream over a surface area of the dilution treatment chamber by subjecting the particle stream to a nozzle treatment fluid pressure effect, or a distributor 14, for horizontal dilution; iii) vertically diluting the particle stream by directing the particle stream in the dilution treatment chamber 12, to a falling condition accelerated by means of gravity; iv) projecting the different components of particle stream by subjecting the particle stream to a treatment fluid at predetermined or various velocity pressures through a nozzle 14, with adjustable orifice outlet 41, which produced the different pressure jet stream impact force related to the kinetic energy transformation creating a high impact. The treatment fluid impacts all or part of the different components depending of the adjustment of the fluid volume, velocity and pressure across the particle stream in said falling condition. The impact forces are transmitted to the different components of the particle stream in order to move and project them across the surface area and within the volume of the dilution treatment chamber 12. The impact force increases the spacing between the particles. These impact force produce a relatively large mass dilution of the particles stream. These process dilute the particle masses for a instantly dilution of the previous masses. The dilution allows projection of the different component of particle stream away from a remainder for the separation

process and let the different groups of components exit and separate locations. The jet stream projects all the different components in all directions in the dilution treatment chamber for mixing. These processes may also use any suitable treatment fluid for treating the particle stream.

[0014] Still further in accordance with the present invention, there is provided an apparatus for at least one of mixing and treating particle and/or stream, comprising a dilution treatment chamber 12, defining an upstanding passageway 20, having an inlet 21, at a top end, and an outlet 22, at a bottom end, the passageway 20, being adapted to receive said particle and/or fluid streams at the inlet such that said particle and/or streams fall toward the outlet; at least one treatment fluid aperture 25, in the dilution treatment chamber 12, adapted to create a generally lateral flow of at least one of a fluid and jet within the passageway 20, to create a turbulence in the passageway 20, for at least one of mixing said particle and/or streams and treating said particle and/or fluid streams, whereby a mixture and/or treated matter will exit the passageway 20, at the outlet 22; and a positive pressure source connected to the fluid flow aperture to create the lateral flow of at least one of the fluid and the particle with a jet stream having a high velocity pressure.

[0015] Still further in accordance with the present invention, there is provided a method for at least one of treating and mixing particle and/or fluid streams, comprising the steps of: i) vertically diluting particle and/or fluid streams by directing particle and/or fluid streams to a falling condition; ii) creating a lateral flow of fluid and/or a particle jet stream with high velocity pressure across the particle and/or fluid streams in said falling condition for at least one of mixing the particle and/or fluid streams by the a turbulence resulting from the lateral flow of fluid and/or particle jet stream, and treating said

particle and/or fluid with a treatment fluid; and iii) collecting the mixture and/or treated matter below the lateral flow.

[0015.A] In some embodiments of the invention, the method and apparatus lets the particles decelerate, agglomerate and settle in the transfer chamber 13, and exiting by the transfer chamber outlet 31.

[0015.B] Advantageously, the claimed apparatus is able to process relatively large quantities of particles relatively fast.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Having thus generally described the nature of the invention, reference will now be made to the accompanying drawings, showing by way of illustration a preferred embodiment thereof and in which:

[0017] Fig. 1 is a schematic view of an apparatus 10, for processing a particle stream in accordance with a preferred embodiment of the present invention, and of a method for separating the particles stream;

[0018] Fig. 2 is a perspective view of the apparatus in accordance with a preferred embodiment of the present invention;

[0019] Fig. 3 is a further perspective view of the apparatus of Fig. 1;

[0020] Fig. 4 is a perspective view of a nozzle to be used with the apparatus of the first embodiment;

[0021] Fig. 5 is a perspective view of the apparatus in accordance with a second embodiment of the present invention;

[0022] Fig. 6 is a perspective view of a lateral particle separator to be used with the apparatus of the second embodiment;

[0023] Fig. 7 is a perspective view of a recuperator tray of the apparatus;

[0024] Fig. 8 is a schematic view of an mechanical distributor impeller used to create horizontal dilution of a particle stream in accordance with an alternative embodiment of the present invention;

[0025] Fig. 9 is a schematic view of a laterally reciprocating strainer in accordance with a further alternative embodiment of the present invention; and

[0026] Fig. 10 is a schematic view of an apparatus for separating particles stream in accordance with a still further alternative embodiment of the present invention.

[0026.A] Fig. 11 is a schematic transversal section through the dilution treatment chamber 12, in order to clarify the details of the movable side wall of the passageway 20.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] It is pointed out that the present invention is associated with processing a stream of particles for separating, mixing or treating, or any combination thereof, the different components having different properties of a particles stream. For example, the components have different masses. The term "particles stream" is broadly used herein to designate a different component mass of particles, granules, pellets, and other elements such as any kind of solids and/or fluids of different mass and volume gathered together. Various uses of the present invention are defined hereinafter, for which the components and/or elements that are processed is referred to as particle stream. Also, the present invention uses the high velocity pressure of a jet stream which contains a relatively large kinetic energy. This energy is transferred at least in part to particles stream components to move, distribute, project, and settle the different components of the particle stream. A jet stream is defined on a high impact speed air stream blowing and producing high energy in relatively short time exposure.

[0028] Referring to the drawings, and more particularly to Fig. 1, an apparatus for processing a stream of particles generally shown at 10. The apparatus 10, shown in the drawings is a typical apparatus according to the invention. The reader skilled in the art will readily appreciate that many other geometric shapes and configurations are within the scope of the invention. The apparatus 10, has a substantially parallelepipedic dilution transfer chamber 12, a substantially parallelepipedic transfer chamber 13 adjacent to the dilution treatment chamber 12, sharing a wall 23, between the transfer chamber 13 and the dilution treatment chamber 12, a nozzles 14 serially mounted on the dilution treatment chamber 12, and a pretreatment module 15. It is pointed out that the nozzles 14 are affixed with letters in various figures, whereby reference to the nozzles 14 will relate to all nozzles (e.g., nozzles 14A, 14B and 14C), while reference to a specific one of the nozzles will include an affixed letter.

[0029] The dilution treatment chamber 12 performs a dilution of a particle stream by producing a de-cohesion of the different component gathered together in the particle stream with a treatment fluid impact force. The treatment fluid is a fluid that is involved in the separation, mixing or any other suitable treatment of the particle stream. The impact force is created by a jet stream of a fluid. More specifically, the impact force is created by a high velocity pressure of the fluid exerted on the particles, which is the only component of the stress tensor describing the fluid/particle interaction that may produce an impact. The other non-zero components of this stress tensor represent frictional forces between the fluid and the particles. In some embodiments of the invention, the treatment fluid impact force creates a relatively large distance between the particles. The extent to which the particles are diluted on many parameters. For example, the following parameters influence the dilution: 1) surface area of the dilution

treatment chamber 12; 2) adjustment of the jet stream impact force; 3) number of stage of projection of the treatment fluid; 4) length of the dilution treatment chamber 12, among others. All these parameters determine the de-cohesion rate between each component and the dilution of the particle stream masses.

[0029.A] The nozzle jet stream and the action of gravity perform a step of separation, and/or mixing and/ or treatment of the different components of the particle stream.

[0029.B] High impact is created by a high speed movement with a very short time exposure creating the velocity pressure jet stream. Jet stream is defined an a high impact speed air stream blowing and having high kinetic energy. The high impact force is proportional with the square of the velocity of the treatment fluid. For example, to obtain one hundred Newton forces with high velocity pressure, you will use one mass of treatment fluid by ten speed squares in comparison of hundred mass of treatment fluid by one speed square. This example prove that the speed of the treatment fluid is the most important factor to create the force.

[0029.C] One other step to increase the dilution rate of the particle fluid stream is performed when the stream reaches the inlet of the passageway 20, of the dilution treatment chamber 12. A distributor 14, one or more nozzles 14, or both then dilute many times the previous mass concentration of the particle fluid stream. In embodiments of the invention wherein a nozzle 14, is present, the nozzle creates a treatment fluid jet stream, which in turn creates an impact force through the action of the high velocity pressure of the treatment fluid. As described in further details in this document, a relatively large high kinetic energy is thereby transferred to the components of the particle fluid stream to move the components for distributing the particle fluid stream on the cross section area of the dilution treatment

chamber. These processes dilute many times the mass concentration of the particle fluid stream.

[0029.D] After this step, the particle stream accelerates as it falls through the passageway 20, of the dilution treatment chamber 12. This further multiplicate the dilution of the particles stream to obtain a dilution of the particles stream suitable for the next processes.

[0029.E] The dilution achieved is related to the length of the passageway 20, and the dilution treatment chamber 12. This length allows for increasing the previous speed of the particle fluid stream, which is accelerating under the influence of gravity. Since the particle stream accelerates, mass conservation requires that the particle stream be diluted. This multiplication of the dilution is related on the speed up to which the particle stream is accelerated. The length of the dilution treatment chamber 12, and the location of the nozzles 14, are selected such that a dilution factor suitable to achieve successfully the separation, mixing or treatment to perform is obtained. After this step, the particle stream reaches at least one other nozzle that also produces a treatment fluid jet stream impact force with a high velocity pressure impacting through the particle stream in the dilution treatment chamber 12, to move the particle or fluid. The total distance over which the particles are moved depends on the masses of the different components of the particle stream and the magnitude of the impact force.

[0029.F] At this stage, the particle stream has been diluted many times and its speed has been increased many times. The particles contain relatively large amounts of kinetic energy because of their relatively high speeds. Therefore, the velocity pressure with the high speed produced by a nozzle 14, is set for creating a relatively high impact force to move the particle stream over a first and also a second distance in transversally direction of the particle fluid

steam in the falling direction. To perform this high impact force action, which is related to the square of the speed at the outlet 41, of the nozzle 14, by the mass of the treatment fluid, this method uses a relatively small amount of treatment fluid having a relatively high speed. The treatment fluid is then able to move laterally at least a portion of the particle stream without floating and entraining big amounts of air with the particle.

[0029.G] The treatment fluid jet stream speed decreases faster than the speed of the particles that have been impacted by the treatment fluid due to the higher inertia of the particles. This causes the particles stream to move over a first and second distance due to ballistic effects, the total of which is relatively higher than a distance over which the treatment fluid moves. The velocity pressure and the speed of the treatment fluid create relatively large effects with a relatively small volume of the treatment fluid.

[0030] The transfer chamber 13 is in fluid communication with the dilution treatment chamber 12 and receives selected components groups of particle stream and a remainder of the particle stream in the dilution treatment chamber 12.

[0031] The nozzles 14 are used to create the dilution of the particle stream in the dilution treatment chamber 12 and to project a jet stream (to be discussed hereinafter) that distributes, mixes, treats or separates the different components of particle stream. Moreover, the nozzles 14 are used to project the treatment fluid in creating a jet stream at different rate and velocity pressure which selects the type of process, by projecting away from a remainder for separating, in all directions the different components for mixing, by injecting the treatment fluid for treating the different components of particle stream. All these processes may be performed sequentially or simultaneously, using one or

a plurality of nozzles for separate or simultaneous processing.

[0032] The pretreatment module 15 is used to guide and spread out the particle stream toward the dilution treatment chamber 12, such that the particle stream will have predetermined velocity. The velocity will cause a dilution of the particle stream.

DILUTION TREATMENT CHAMBER 12

[0033] Referring concurrently to Figs. 1, 2 and 3, the typically parallelepipedic dilution treatment chamber 12 is shown having an upstanding elongated shape, and defines a substantially vertical passageway 20 of substantially rectangular cross-section. Although a rectangular cross-section is described, any other suitable cross-section shapes are contemplated. The passageway 20 has an inlet 21 at a top end thereof and an outlet 22 at a bottom end thereof. The dilution treatment chamber 12 shares a wall 23 with the preferably parallelepipedic transfer chamber 13. Transfer apertures 24, positioned opposite the treatment fluids aperture 25, are provided in the wall 23, between the dilution treatment chamber 12 and the transfer chamber 13. Moreover, the dilution treatment chamber 12 may vary in cross-sectional dimensions. For instance, appropriate translating mechanisms may be provided so as to increase/decrease a length or width of the cross-section parameters of the dilution treatment chamber 12.

[0034] The dilution treatment chamber 12 also has treatment fluid pressure-differential apertures 25 (herein three apertures, i.e., treatment fluid apertures), two of which are horizontally positioned opposite the transfer aperture 24 in the wall 23, between the dilution and transfer chamber.

TRANSFER CHAMBER 13

[0035] Referring concurrently to Figs. 1, 2 and 3, the transfer chamber 13 defines an inner transfer chamber 30. The inner transfer chamber 30 has a funnel-shaped outlet 31 at a bottom end thereof, so as to collect selected components of particle stream and allow deceleration and mass reconcentration of the components for settling in the transfer chamber 13.

[0036] Referring to Fig. 5, a lateral particle separator 60, in accordance with another embodiment of the present invention, is received in the inner transfer chamber 30 of the transfer chamber 13. The lateral particle separator 60 will be described in further detail hereinafter, and is used to cause a further particle group separation.

NOZZLE 14

[0037] Referring concurrently to Figs 1, 2 and 3, the nozzle 14B and 14C are positioned opposite the transfer aperture 24 of the dilution treatment chamber 12. The nozzle 14, may take various geometric shape and configurations. For instance, the nozzle are connected to a pressure source so as to produce a treatment fluid jet stream (e.g. of any kind of elements) into the passageway of the dilution treatment chamber 12. For example, and non-limitingly, the fluid includes air or any other suitable gas.

[0038] Referring to Fig. 4, one of the nozzle 14 is illustrated in greater detail. The nozzle 14 has an inlet 40, by which it is connected to a pressure source, and an outlet 41 of elongated shape. The nozzle 14 has a diffusing divergent/convergent body 42 between the inlet 40 and the outlet 41.

[0039] In a preferred embodiment of the present invention, the diffusing body 42 has an accumulator portion 43 connected to the inlet 40, and convergent tapered diffusing sectors 44 between the accumulator portion 43 and the outlet 41. The

diffusing sectors 44 are used in order to create a substantially uniform diffusion of treatment fluid out of each of the nozzle 14.

[0040] A gate 45 is displaceable vertically for the adjustment of the height of the outlet and surface area 41. A connection flange 46 is used to secure the nozzle 14 to the dilution treatment chamber 12 opposite the treatment fluid apertures 25. It is also seen in Figs. 2 and 3 that the gate 45 can be accessed from an exterior of the apparatus 10, thereby enabling the rapid adjustment of the outlet size of the nozzle 14 from an exterior of the apparatus 10.

[0040.A] Displacement of the gate 45 controls, at least in part, the rate and velocity of the treatment fluid so that the velocity of the treatment fluid is a predetermined velocity. The predetermined velocity controls at least in part the predetermined impact force to achieve a predetermined processing of the stream of particles. Other parameters of the apparatus 10 are also selectable so as to adjust the treatment fluid to obtain a predetermined impact force.

[0041] The above-described configuration of the nozzle 14 enables a high-pressure, low-volume output of treatment fluid into the dilution treatment chamber 12 to produce a high impact which is created by a high velocity pressure jet stream (e.g. moving at a relatively fast rate with short time exposure) with a relatively large kinetic energy, this energy being transferred at least in part to the particles for projecting the particles at different distances depending of their masses and other characteristics.

[0041.A] In other words, a stream of particles flowing substantially along a stream flow direction is diluted by a treatment fluid in the form of a diluting flow of fluid directed towards the stream of particles, the diluting flow of fluid flowing substantially along a diluting flow of fluid direction.

[0041.B] The diluting flow of fluid has a velocity and density such that the fluid produces a high impact with a diluting impact force on the particles causing the particles to move over a first distance in a direction substantially parallel to the diluting flow of fluid while the fluid produces the diluting impact force and to move over a second distance in a direction substantially parallel to the diluting flow of fluid after the fluid has produced the diluting impact force. The diluting impact force is of a magnitude and duration such that the particles are substantially separated from each other by the diluting flow of fluid the second distance is substantially larger than the first distance.

[0041.C] In some embodiments of the invention, the movement of at least some of the particles caused by the diluting flow of fluid is such that the treatment fluid jet stream speed decreases faster than the speed of the particles that have been impacted by the treatment fluid due to the higher inertia of the particles. In other embodiments of the invention, the high impact is such that the second distance is larger than the first distance.

[0042] Accordingly, the output of treatment fluid jet stream will decelerate at a high rate, and shut down rapidly in accordance with the distance, so as to project in some instances described hereinafter given selected particle out of the dilution treatment chamber 12, for separation and to avoid creating turbulence in the transfer chamber 13. Also the treatment fluid is used for enhancing different processes of mixing and treating the different components of particle stream by impacting and projecting them in all directions in the dilution treatment chamber.

PRETREATMENT MODULE 15

[0043] Referring concurrently to Figs. 1, 2 and 3, the pretreatment module 15 is connected to the inlet 21 of the dilution treatment chamber 12. The pretreatment module 15

conveys the particle stream to the inlet 21 of the dilution treatment chamber 12. More specifically, the pretreatment module 15 will be used to produce specific passageway inlet conditions of the particle stream.

[0044] In a preferred embodiment of the present invention, the pretreatment module 15 has a slide 50, sloping downwardly towards the inlet 21 of the dilution treatment chamber 12. A deflector 51 is positioned between the slide 50 and the inlet 21 of the passageway 20. The deflector 51 has a generally horizontal launch surface, but may also be oriented otherwise. As seen in Figs. 2 and 3, the slide 50 tapers towards the inlet 21 of the dilution treatment chamber 12, so as to have an outlet 22, width generally equal to the inlet 21, width of the passageway 20 of the dilution treatment chamber 12. The slide 50 is preferably provided with guiding rails 52 for guiding the particle stream (Figs. 2 and 3). The particle stream reaching the slide 50 is preferably uniformly distributed toward the inlet 21 of the dilution treatment chamber 12.

[0045] A further slide 53 is optionally provided above the slide 50 so as to dampen the fall of the particle stream from the conveyor C. The slide 53 will absorb a portion of the downward force, and will absorb the lateral velocity transmitted from the conveyor C to the particle stream, such that the particle stream reaches the dilution treatment chamber 12 at predetermined velocity parameters.

[0046] It is contemplated to provide various geometries configuration to the pretreatment module 15. For instance, the slide 50 is herein illustrated as being generally a flat, inclined surface. However, it is contemplated to provide the slide 50 with a downwardly-tapered frusto conical shape. Moreover, for such an embodiment, the slide 53 preferably has an upright conical shape.

THE OPERATION OF THE APPARATUS IN SEPARATION, MIXING AND TREATING

[0047] The apparatus 10, can process simultaneously or separately the particle stream for separation, mixing, or treatment. Now that the various components of the apparatus 10 have been described, the processing operation of a stream of particles of the apparatus 10 is set forth.

[0048] Referring concurrently to Figs. 1, 2 and 3, a particle stream is fed by the conveyor C to the apparatus 10. The particle stream has a vertical velocity and will accelerate downwardly when leaving the conveyor C due to gravitational forces.

[0049] The slide 53 will absorb a portion of the downward force of the particle stream, and stop the lateral velocity of the particle stream that had been transferred to the particle stream by the action of the conveyor C. The particle stream is directed by the slide 53 toward the slide 50 of the pretreatment module 15, at generally predetermined velocity conditions.

[0050] Upon reaching the slide 50, the particle stream will be guided by the guiding rails 52 so as to be conveyed uniformly towards the dilution treatment chamber 12 as a result of the downward slope of the slide 50. The downward slope of the slide 50 will cause the particle stream to accelerate.

[0051] The deflector 51, having a launch surface, will deflect the particle stream so as to spread out the particles stream. A dilution will be the result of the deflection of the particle stream by the deflector 51. Accordingly, the particle stream will reach the dilution treatment chamber 12, having been subjected to a dispersion for the next dilution by the treatment fluid velocity pressure produce with the nozzle 14, or with the distributor 14. Also the pre-treatment module are use for fluids stream.

[0051.A] The particle stream then fall in the dilution treatment chamber for horizontal dilution by a distributor and/or a nozzle with additional multiplication of dilution cause by vertical gravity force acceleration and plurality of nozzles of the particle stream and more specifically, creating space between component for a relatively large dilution of mass/volume and a relatively large de-cohesion of the different components of particle stream.

[0052] A first one of the nozzles 14, namely nozzle 14A, will project a treatment fluid jet stream within the passageway 20 of the dilution treatment chamber 12 so as to cause a de-cohesion of the component and a mixing and distribution the different components of the particle stream over the cross-sectional area of the dilution treatment chamber and dilute and creating space between the particles. As an alternative to a nozzle 14, a distributors 14, may be provided with vibrating strainers, impellers, or the like, as will be illustrated hereinafter.

[0053] The particle stream, having been subjected to a horizontal and a vertical dilution for a maximum de-cohesion of the different component before the next step of the treatment which continuing the de-cohesion in the same time of processing the treatment, the particle stream now subjected to a relatively large de-cohesion creating a dilution, will be crossing a treatment fluid jet stream substantially perpendicular to the particle stream in said falling direction projected by at least one others nozzle 14B, and the optional third nozzle 14C. The nozzles 14B and 14C project treatment fluid, at a predetermined or variable pressure effect through the treatment fluid aperture 25, which are positioned opposite the transfer aperture 24, such that the treatment fluid jet stream will project the selected components of particle stream in the dilution treatment chamber through the particle stream and/or out of the dilution treatment chamber 12, by the opening through the transfer aperture 24, into the transfer chamber 13, with a

high ratio of particle treatment fluid concentration. The projected treatment fluid by the nozzles 14 is at the predetermined pressure, such the other particles will not be projected out and remain in the particle stream depending. In other words, some particles are projected over a larger distance, which creates a separation of these particles from other particles present in the stream of particles. The dilution that has taken place previously is an important factor in the different processes of separation, mixing or treating. The magnitude of the pressure of treatment fluid projected will have a direct effect on the particles being withdrawn from the particle stream in the dilution treatment chamber 20. It is pointed out that the vertical distance from the inlet 21 to the nozzle 14B is an important factor in diluting the particle stream to facilitate the subsequent processes so as to increase the contact with the treatment fluid.

[0054] Although plurality of nozzles (namely 14A, 14B and 14C) are described, the number of nozzles 14 is variable according to the present invention. The apparatus 10 is operative with a single nozzle 14 including a treatment fluid aperture 25, but a plurality of nozzles 14 may be serially added on the dilution treatment chamber 12 to increase the efficiency of the operation taking place within the dilution treatment chamber 12.

[0055] Thereafter, the selected particle exits through the transfer chamber outlet 31 at the bottom of the transfer chamber 13 after settling, whereas the remaining particle stream continues its drop into the dilution treatment chamber 12 toward the dilution treatment chamber outlet 22.

[0056] As mentioned previously, the apparatus 10 of the present invention is usable for simultaneous or separately process and for mixing, treating the different components of particle stream, depending on the adjustment of the nozzle 14, the dilution rate and the impact force. Therefore, a

processing mixing/treating operation of the apparatus 10 is set forth.

[0057] Referring to Fig. 1, particle streams to mix and/or treat have horizontal and vertical dilution velocity and will accelerate downwardly when leaving their source due to gravitational forces as similarly set for the separate process, just different adjustment will be take place as described previously.

[0058] A first one of the nozzles, namely nozzle 14A, will laterally project treatment fluid jet stream with velocity pressure effect or any other suitable fluid or particle jet, within the passageway 20 of the dilution treatment chamber 12 so as to cause a turbulence and move in all directions the different components of particle stream for another step of de-cohesion for mixing and/or treating the particle and/or fluid streams. The treatment fluid jet stream projected by the nozzle 14A at a predetermined pressure depending of the adjustment of the pressure source and the nozzle gate 41, to produce the different jet stream impact forces through the particle stream to be mixed so as to have a variable effect relative to the size, mass and other characteristics of the particles and/or fluid streams. The nozzle 14A fluid projects treatment fluid, or any other suitable fluid, at high pressure and low volume.

[0059] In option, we can use the opposite transfer apertures 24 which are not used in the mixing process of the apparatus 10. The nozzles 14B and 14C are optionally used with the opposite transfer aperture 24 being blocked with the gate 26, so as to create further turbulence, as it is contemplated to provide a plurality of the nozzles 14 to create different rate of mixing of different components of particle stream in the dilution treatment chamber 20, and treating the different component particle stream by the treatment fluid injected. Additional nozzles may also be added to the apparatus 10.

[0060] Thereafter, the mix or treated matter, resulting from the mix/treatment of the particle and/or agent stream, continues its drop into the deconcentration treatment chamber 12 toward the outlet 22. Also the transfer aperture are use for exiting the mixed or treated particle stream.

ADDITIONAL COMPONENTS OF THE APPARATUS 10

[0061] It is contemplated to provide additional components to the apparatus 10 in order to optimize the separation of the particle stream into particle groups.

[0062] Referring to Figs. 5 and 6, a lateral distributor is generally shown at 60. The lateral distributor 60 is positioned in the transfer chamber 30 of the transfer 13. Referring more specifically to Fig. 6 in which all reference numerals are shown to simplify Fig. 5, the lateral distributor 60 is shown defining three upstanding sectors 61, each converging to a segmented outlet portion 62. Each of the sector 61 has a respective collecting surface 63 upon which particles coming from the dilution treatment chamber 12 will be collected. An air flow outlet 64 is provided downstream of the upstanding sectors 61 to allow an appropriate flow of air, that will not impede on the lateral flow of air (or gaseous fluid) out of the lateral outlets 24 of the dilution treatment chamber 12.

[0063] More specifically, the lateral distributor 60 operates with the principle that the distance traveled is a function of the particle size parameters (e.g., surface area, mass). Accordingly, coarser particles will travel a shorter distance than finer ones, whereby the coarser particles will be collected by the upstream sector 61. Therefore, a further particle group separation takes place with the lateral distributor 60. The hence separated particle groups are collected separately at the segmented outlet portion 62.

[0064] Referring to Figs. 3 and 7, recuperation trays 70 are provided below each of the transfer apertures 24 of the

dilution treatment chamber 12. More specifically, it is possible that components of particle stream that should selectively remain with the dilution treatment chamber 12 are deflected out of the transfer aperture 24. These particles will not travel a long distance out of the transfer aperture 24 due to their mass parameters. Accordingly, the recuperation trays 70 are provided to collect these particles, as they are positioned directly below the apertures 24. These particles are returned to the dilution treatment chamber 12 by the sloping shape of the recuperation trays 70.

[0065] Moreover, the recuperation tray 70 illustrated in Fig. 7 have various configurations also effects a particle separation. More specifically, the recuperation tray 70 has a first sector 71 and a second sector 72. The first sector 71 collects the particles that should not have left the dilution treatment chamber 12, whereas the second sector 72 collects rapidly falling particles, of a grade just below that of the particle group remaining within the dilution treatment chamber 12. It is pointed out that the second sector 72 is connected to its own outlet.

[0066] Also, the recuperation tray 70 may be pivotally connected at a bottom edge thereof to the wall of the dilution treatment chamber 12. This would enable adjustment of an angle of the recuperation tray 70 with regard to the vertical, as a function of the particle stream being selected.

[0067] Fig. 8 and 9 illustrate alternatives of the nozzle 14A. In Fig. 8, an impeller is shown at 80. In Fig. 9, a laterally reciprocating strainer is generally shown at 90. Both these alternatives will cause a dispersion and dilution of the particle stream. Other alternatives include, electrostatic or magnetic emitters (e.g., in accordance with the type of particles stream being treated), as well as any mechanical or ultrasound system.

[0067.A] Fig. 11 illustrate a transversal section of the dilution treatment chamber 12, where is detailed the transversal movement of passageway side wall 20, used for adjusting the cross sectional area of the dilution treatment chamber 12.

[0068] It is also contemplated to inject additives to the particle stream being diluted in the dilution treatment chamber 12. For instance, an aperture such as one of the treatment fluid pressure-differential apertures 25 can be used with a suitable injection system (e.g., pressure source and conduit combination) to inject any kind of treatment agent to the particle stream being diluted in the dilution treatment chamber 12, or to particle being mixed therein.

[0069] It is also contemplated to provide a plurality of the apparatus 10 in series, with a conveying system transporting/conveying the output of an upstream one of the apparatus 10 to a downstream one. Alternatively, a pair (or more) of the apparatus 10 may be positioned in parallel and/or share a common transfer chamber 13, to collect a specific component of particle stream. In such a case, the transfer chamber 13 could be used to mix a different components of particle stream from a first dilution treatment chamber 12 with other components of particle stream of a second dilution treatment chamber 12.

[0070] For instance, referring to Fig. 10, an apparatus in accordance with an alternative embodiment of the present invention is generally shown at 10'. The apparatus 10' is similar to the apparatus 10 of Fig. 1 in that the apparatus 10' has a dilution treatment chamber 12, nozzles 14 (herein four nozzles for the dilution treatment chamber 12), and a pretreatment module 15'. The pretreatment module 15' shows a different shape (e.g., with a conical slide 53'), but operates in a fashion similar to that of the pretreatment module 15. The apparatus 10' has a transfer chamber 13' in

which a secondary separation and/or mix and/or treat is performed.

[0071] More specifically, the transfer chamber 13' has a transfer plate 100, a dilution treatment chamber 102, nozzles 104, and a second transfer chamber 106. The components of particle stream reaching the transfer chamber 13' from the dilution treatment chamber 12 will drop into the inlet of the dilution treatment chamber 102, or will settle onto the transfer plate 100, to then reach the inlet of the dilution treatment chamber 102.

[0072] Optionally, the transfer plate 100 is provided with a vibrator 108 so as to avoid having particles collect thereon. The transfer plate 100 could also be provided with a low adherence coating, such as PTFE.

[0073] The dilution treatment chamber 102 is illustrated having the nozzles 104A, 104B, and 104C. The nozzle 104A serves the same function as the nozzle 14A of Fig. 1, namely to distribute the particle stream that has reached the dilution treatment chamber 102. The nozzle 104A can be replaced with other devices, such as those illustrated in Figs. 8 and 9.

[0074] The nozzles 104B and 104C serve the same function as the nozzles 14B and 14C of Fig. 1, and are thus positioned opposite the transfer aperture 110, through which selected components of particle stream will be forced out, to reach the transfer chamber 106 and settle therein. The removed particle will exit through outlet 112, whereas the remaining particles will exit through dilution treatment chamber outlet 114. Recuperation trays 116 are adjustable similarly to the recuperation trays 70 of the preferred embodiment.

[0075] Accordingly, the output of the apparatus 10' are three different components particle groups, with their separated and/or mixed, and/or treated particle group exiting from the passageway 20, 102, and transfer chamber

106. It is pointed out that the treatment fluid jet stream output of the nozzles 14 and 104 is adjusted in view of the desired process of the stream of particles selected. The dilution transfer chamber 13' are used for separating, mixing or treating, as described previously for the apparatus 10.

USES

[0076] Amongst the various process that can take place with the apparatus 10-10' of the present invention, it is contemplated to separate, treat, mix, add, vaporize, clean, calibrate, or eliminate components from particle streams. Other treatments, such as painting, coating, sandblasting, cleaning, and so forth can be effected with the apparatus 10-10' of the present invention. Existing batch processes, such as the injection of gas or chemicals into soft drinks, can be converted to continuous processes using the present invention.

[0077] The differential velocity pressure in the dilution treatment chamber 12 can be controlled electronically and the apparatus 10 may be combined to magnetic, electrical, ultrasound, electronic, and electromagnetic systems.

[0078] The apparatus 10-10' can be used with all kinds of materials, such as: mineral, vegetable, biological, or organic aggregates, as well as with fertilizers, treatment or transformation residues, waste, food products, drugs and other pharmaceutical products, powders, agriculture related products, chemical or metallurgical products, compost, plastics and composites, paper, soil and bio-soil, ashes, crushed stone, ceramics, coal, and any kind of suitable elements.

[0079] The apparatus 10-10' of the present invention is relatively small. Accordingly, it is possible to place the apparatus 10-10' at various parts of a process due to these advantageous features. The apparatus 10-10' enables large quantities of particles streams to be treated in a

relatively limited amount of space, with little wear of material, low energy consumption and, in some embodiments, no moving parts (i.e., depending on the choice of the type of dilution).

[0080] The apparatus 10-10′ can be used as part of a multi-step or multi-pass process. For instance, the preferred embodiment includes a transfer chamber 13, 106, for the collection of the selected particles. The apparatus 10-10′ is made of rigid materials, such as metals, polymers, and so forth. It is pointed out that aside from the slide 53, the apparatus 10-10′ goes through limited wear.

[0081] It is within the ambit of the present invention to cover any obvious modifications of the embodiments described herein, provided such modifications fall within the scope of the appended claims.